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STUDENT REPORT

MATRIX MANAGEMENT IN DOD:
AN ANNOTATED BIBLIOGRAPHY

MAJOR DAVID A. WIEDERHOLD

84-2780

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MATRIX MANAGEMENT IN DOD:
AN ANNOTATED BIBLIOGRAPHY

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PREFACE

This annotated bibliography was requested by the Headquarters, Air University Leadership and Management Development Center (HQ AU/LMDC) to support their studies of the non-traditional organizational design concept, matrix management. This LMDC effort is part of a much larger study project requested by Headquarters, United States Air Force/Manpower and Organization (HQ USAF/MPMO) to examine all non-traditional methods of structuring organizations.

At the request of the LMDC, this product has been prepared in the format of the American Psychological Association (APA), and selected portions have been typed double-space.

ABOUT THE AUTHOR

The author's experience in matrix management began in 1976 when he left the field of Space Operations and joined Data Automation under the Air Force Tactical Air Command. In this new career field, he served seven years as section, branch, and division chiefs developing combat and support software for the Tactical Air Control System and the Airborne Warning and Control System. In these assignments he experienced the matrix concept as a functional manager, a project manager, and the general manager overseeing the matrix activity.

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MATRIX MANAGEMENT IN DOD:
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Introduction

This annotated bibliography is designed to collectively examine the Department of Defense's (DOD) literature about matrix management over the past decade. These writings are important since matrix is a relatively new concept that is contrary to the traditional structure of the military. Traditionally, the military has been organized functionally with its relatively clear cut lines of authority and responsibility. In the past 20 years, though, this organizational structure has been inadequate for certain jobs. This inadequacy is particularly true in managing the research, development, and acquisition of systems that are based on high technology. Recognizing this fact, civilian industry first started developing alternate organizational forms to keep up with the demands for single point accountability, short communication channels, high control capability, and assured technology transfer (Systems Engineering Management Guide, DSMC 1983). Functional organization led to project organization, and multiple projects led to program management. Finally, to make optimum use of limited personnel resources, industry combined these previous structures to form a hybrid called "matrix management." This new approach had obvious advantages and was subsequently adopted by the military through the 70s. Now formally taught and practiced by industry and DOD alike, matrix has been the subject of numerous books, articles, studies, and reports.

Method

The search for this paper's candidate literature spanned a wide variety of civilian and military sources. These sources included books, articles, research reports, and official DOD directives and guidance. Note, however, the search of regulations, manuals, pamphlets, guides, and catalogs below the DOD level was limited to Air Force only.

The search tools were both automated and manual. The automated searches were provided by the Defense Logistics Study Information Exchange (DLSIE) and the Defense Technical Information Center (DTIC). Manual searches were conducted at the Air Force's Air University Library and Leadership and Management Development Center (LMDC). The literature was largely located by scanning the Business Periodicals Index published by the H. W. Wilson Company, the Air University Library Index to Military Periodicals, Air University Special Bibliography No. 270 compiled by bibliographer Mary Lou Sauer, and the annual catalogs of student research reports from the Air Force Institute of Technology (AFIT), Air War College (AWC), Air Command and Staff College (ACSC), and the Defense Systems Management College (DSMC). Additional leads were also found in the bibliographies of the annotated literature contained within these pages.

The size of this annotated bibliography was controlled by expanding or narrowing the search criteria. These options included shorter or longer time periods than "1973 to present," and expanding the search beyond DOD or limiting it to Air Force Major Command (MAJCOM), or lower functional levels.

The automated and manual searches provided an abundance of material to screen since discussions on matrix were often included under the general topics of management, program management, project management, organizational structures, and others. Thus, unless a title or subject specified "matrix

management," candidates often had to be selected on the basis that the title simply appeared promising (e.g. Principles of R&D Management by Wall).

This search methodology identified 86 works that had to be further screened by reading or scanning each individually. Acceptable literature satisfied at least one of four criteria: (1) Specifies "matrix organization" or "matrix management"; (2) Discusses "borrowed resources" in program or project management; (3) Discusses management aspects closely related to matrix (e.g. "Conflict management in project-oriented environments"); or (4) Details DOD, Air Force, or MAJCOM level organizational structure or management techniques closely associated to matrix.

Organization

Each reference in this bibliography has been annotated in a format that (1) provides immediate information on matrix management and (2) enables the reader to evaluate if the source should be located to learn more. Each annotation begins with a general description of the work's scope and purpose. This is followed by a discussion of the author's main points, his/her source of information, and an evaluation of the work's limitations, strengths, or comprehensiveness.

Each annotated reference is also grouped in one of four categories determined by its informational basis. The groups are: (1) author's opinion/experience as an authority; (2) literature review; (3) data/survey results; and (4) official guidance. However, this categorizing was not always a clear-cut task. For example, data/survey based literature also had limited literature reviews and generally finished with the author's opinion to draw conclusions. In this case, though, the work was still considered data/survey based. References with an extensive bibliography were considered literature search based. Those with few or no references were considered opinion.

Synthesis

Synthesis of Literature Discussions

In general, DOD literature on matrix management is positive and describes the increased use of the concept throughout the decade. In 1976, the Air Force Systems Command completed a major reorganization of its Aeronautical Systems Division under the matrix concept to solve long standing problems in research and development (Zambenini, 1977). In 1978, Wall describes how the Air Force and Army even employed a refinement in the original matrix concept, the "two-tier matrix organization," to improve the F-15 aircraft and Hawk missile acquisition programs. On a larger scale, the Navy published its lesson learned after reviewing more than 100 major weapon system acquisition programs and found that matrix was essential in view of the limited personnel resources available to the expanding number of programs (Harvey, 1980). More recent evidence of the increased application of matrix in DOD appears in the January-February 1984 issue of the Army Logistician. Here, Jacobs describes how matrix management provides the framework for a program to improve the management of more important projects in the Army Material Development and Readiness Command. Thus, the success and growth of the matrix management in DOD continues and is encouraged. This encouragement is evident in Air Force Regulation 26-2, Manpower: Organization Policy and Guidance, as it states that the "MAJCOMs are encouraged to develop and test new organizations that promise to increase effectiveness and efficiency."

Much has been learned from this increased use of matrix in DOD. Almost every discussion of its application includes some important thoughts and observations that can be categorized under the headings of advantages, disadvantages, and advice.

Advantages. The advantages of matrix management are as much a benefit to DOD as they are to civilian industry. To date, matrix is likely the best form of management to handle high priority, technically demanding, and fast changing programs. Thus, the concept appears tailored for the challenge of modern research and development; however, matrix also promises a much wider application to other activities. An example is in logistics where it may be helpful to integrate the functional elements of customer service (Ogan and O'Neill, 1981). Numerous other possibilities, even down to base level, remain (and are encouraged) to be explored.

Matrix is particularly beneficial since it reportedly maximizes the use of limited personnel resources. As programs pass through their various stages of development, the peak demands for talent shift from one functional area to another. Since matrix only loans functional personnel to the projects, people can be reassigned wherever they are needed the most. This practice stabilizes the functional department workload and importantly enables the crossfeed of innovative techniques, new skills, and sharing of experience as the loaned personnel return to their functional areas and colleagues.

Other matrix management advantages include the following: (1) Clear customer interface with single point accountability; (2) Short communication channels; (3) High volume of information exchange; and (4) High control capability.

Disadvantages. The frequent complaints under matrix management are its almost inherent vagueness of authority and dual-boss relationship over the loaned resources. Neither DOD nor civilian industry find it easy to define and maintain a balance of authority between the project and functional managers. This vagueness of authority is constantly present in varying degrees

and is a cause of at least occasional conflict and inefficiency. The ambiguity is also a problem for the loaned personnel who often view themselves as working for two bosses, the project manager and the functional manager. Moreover, if the project boss and his/her borrowed personnel are collocated, the functional manager may not have all of the information he/she needs to write an effective performance evaluation on the loaned subordinate.

As with the advantages, these disadvantages are largely the same for DOD as they are for the civilian sector. DOD, however, is more likely to be sensitive to the vagueness of authority and the two-boss syndrome since they run contrary to the traditional military structure with its clear-cut lines of authority and responsibility.

Advice. Most forms of management are accompanied by innumerable words of wisdom and cautions to heed in order to be successful, and the school of matrix is no different. Seldom would an author present a problem or disadvantage of matrix without also discussing its possible solution. Though the previously described two disadvantages are inherent to matrix and are ever present, authors generally agree that these problems and others could be diminished and the organization efficiency/effectiveness enhanced by practicing or remembering the following:

1. Recognize and resolve the power balance between program and functional managers or matrix will fail.
2. Ensure that the project and functional managers communicate frequently, especially on the subjects of workloads, personnel assignments, and individual achievements.
3. Frustration under matrix can be minimized by in-house training and seminars regarding matrix organization and how the unit is applying the concept.

4. Matrix management can be successful if the managers work at it, and it takes a lot of work.

5. The general manager supervising the project and functional managers is not a part of the matrix, but he/she is still a key ingredient in the concept's successful application.

6. The subjects under matrix arousing the highest frequency of conflict are schedules and priorities.

7. The two best methods for resolving conflict under matrix is confrontation and compromise.

8. Be certain to enforce a strict program of routinely rotating loaned personnel back to their functional departments to share new lessons with colleagues and catch up with state-of-the-art developments in the service being provided (e.g. system engineering, contracting, test and evaluation, etc.).

General Impressions of Literature Categories

As a parting observation, there are general impressions given by each of the four literature categories.

Author's Opinion/Experience. At first thought, the reader may tend not to give information from this area full weight for several reasons. One may question the author's authority, believe the author's viewpoint may not be widespread, or believe the author's experience may be unique and be the exception rather than the rule. Depending on the reference, these concerns could be legitimate; however, this category's information was generally valuable for a number of points. First, an author's work often reflected an organization's consensus of ideas and findings on matrix and not just one person's opinion or unique experience. Second, this category emphasized the practical application

and results of matrix rather than theory. Third, the author may very well be an authority on matrix as a result of his length of experience and variety of jobs associated with matrix management. And fourth, information based on an author's opinion or experience under matrix often expressed new thoughts as opposed to rehashing old concepts.

Literature Review. A pure literature review would simply replot old ground by collecting the viewpoints of several authorities to form a consensus on some aspect of matrix; however, there were no pure literature reviews. After stating generally accepted ideas regarding matrix, an author would invariably introduce an opinion or an observation from experience which he would support by specific or general statements from established sources. This technique was excellent for introducing original thought with credibility.

Data/Survey Results. This category offered a wide point of view on matrix as experienced by those surveyed. At times, it even produced valuable information that an author held as major findings but did not anticipate.

The general approach of this literature group was to form a hypothesis, gather responses to check for hypothesis support or rejection, run the results through a statistical analysis, then draw conclusions. Although the concept is very scientific, its application was often lacking. Several authors gave an impressive statistical analysis, yet almost totally ignored the basics of describing their sample. At least twice it appeared that the representative nature of the sample was either completely assumed or never carefully defined and established from the study's onset. In all fairness, though, the authors often worked under a sampling handicap since their survey was likely a very low priority in the participating organization, and participants were probably whoever was available within general selection criteria.

Official Guidance. One might think that the logical source for advice on matrix in DOD would be DOD, itself. However, this was not the case, and regulations, manuals, and pamphlets down to the Air Force MAJCOM level remain general in giving any direction or guidance. This approach is likely intentional and meant to leave management as much flexibility in choosing whatever organization structure that optimizes effectiveness and efficiency. Still, one may wonder how the military views alternate management forms, like matrix, that may not fit comfortably into the traditional military organization concept. As far as the Air Force is concerned, AFR 26-2 states, "Organization based on functions ... predominates in the overall Air Force structure. However, in an organization as large and complex as the Air Force, the functional approach does not always apply. It is also important to recognize that a particular unit may be organized by function but its subordinate elements may be organized differently."

ANNOTATED BIBLIOGRAPHY

Author's Opinion/Experience

Ballou, P. O. A functional view of organizations. Concepts, 1980, 3 (4), 102-112.

This article is primarily concerned with the administration of certain types of formal organizations, although some of the propositions and theories are probably applicable to all types of organizations. Ballou sets the theme of his article by stating, "within the past 20 to 30 years, a profound change in the main task of management has been emerging as a result of technological growth, information systems, and social expectations of government and industry. The trend in organizations has been away from a fixed bureaucratic hierarchy toward one that is flexible and functional according to its needs" (16).

Ballou's mainpoint is very general. He says that the uniqueness of the matrix concept is underscored by the synergism that results from its interactive relationships. These relationships are the new verticle, horizontal, and diagonal relationships among the organization's members.

Ballou's article draws from his 20 years of industry and government experience in the fields of contract negotiations and administration, including extensive international business experience (16). He supports his ideas with 13 references to publications in management and human behavior.

The article is very limited as it spends less than a page of text discussing matrix and speaks in broad generalities.

Caron, P. F., & Roderick, B. The challenge of program management: Building and motivating a team. Program Manager, 1979, 8(4), 6-9.

The authors discuss and make recommendations on a challenge matrix managers face--building and motivating a team. Although they do not use the term "matrix management," Caron and Roderick address all of the aspects inherent to the program manager who is borrowing functional resources to build his team.

On building the program team, the authors list and discuss six objectives that must be attained. They are: creating a sense of duty to the manager; building a visible reputation as an expert in a relevant area; projecting the image of an ideal person; obtaining and making available the resources people needed to do their jobs; just rewarding people for their contributions; and making clear the limits of a manager's authority.

On motivating the project team, the authors list and discuss five objectives. They are: make goals explicit; ensure goals involve a moderate risk; give prompt, unbiased and relevant feedback on progress; emphasize personal responsibility; and encourage a climate of mutual support and encouragement.

The authors reference persons and studies throughout the text but do not formally footnote supporting literature. They also draw reference to their own research without detailing its nature.

The article limits itself to strictly introducing then discussing the objectives necessary to build a program management team then motivate it. Their opening and closing remarks are brief.

Chapman, D. L. Matrix management: Its effect on productivity. The Military Engineer, 1981, 73(473), 164-167.

The author demonstrates how a project is handled within a matrix system by tracing a typical government project from original contract to construction completion. He lists advantages and disadvantages of matrix and discusses its effects on productivity.

Chapman expresses three main points. He says matrix is best suited to medium or large organizations so key members can be assigned to a project for its duration. Frustration under matrix can be minimized by in-house training and seminars. Finally, "The team concept permits its members to be a part of a smaller group and gives them a strong sense of identity. This creates an incentive to complete the project efficiently and profitably; in turn, the teams are recognized and rewarded for this profitability" (167).

Speaking from 20 years experience as a project manager (seven within matrix management), Chapman covers his topic as comprehensively as possible in four pages. He resorts to a bullet format in places to pack a lot of information into a small space. The article is excellent.

Gowins, E., Ormsby, D., & Rutenberg, D. Creating and sustaining military capability. Maxwell Air Force Base, Alabama: Air Command and Staff College, 1984.

This is a textbook used in Air University's Air Command and Staff College to teach the acquisition and logistics support of modern weaponry. The 506 page volume contains 29 lessons on virtually all aspects of the two subjects, past, present and future, including a look into Soviet logistics and design philosophy. The text's handling of matrix falls under the subject "Program Office (PO)," written by guest authors James W. Huffman, Vincent J. Lozito, Jr., and Larry A. Snyder.

The authors' main point on matrix organization is more implied than a specific statement of fact. Using functional organization charts from AFSCP 800-2, "Acquisition Management: A Guide for Program Management," the authors introduce matrix organization as a format of the multiprogram Program Office. Although they introduce the concept with the statement, "... the functional directorates may be matrixed across many programs ...," the authors also add that matrix organization maximizes "... the use of available, but limited, personnel" (71). This last statement completes their message that matrix organization is the likely format of the multiprogram Program Office.

The text's discussion of matrix is very introductory and limited to a paragraph.

Harvey, P. I. Acquisition review: A help or a hindrance? Defense Systems Management Review, 1980, 3(1), 103-109.

This article is a brief discussion of lessons learned from the acquisition process within the Navy. The lessons are the result of an 18 month review by the Navy's Acquisition Review Board (ARB) of more than 100 major weapon system acquisition programs.

The board found that the Navy must continue to use matrix management since there are only a "finite number of management personnel assets available to fill the increasing list of priority development program needs" (106). However, the board adds that matrix "is not, in and of itself, the solution. Certain other management initiatives in the form of reorganization into functional mission project directorates were recently undertaken to alleviate burdens created by the growing number of programs" (107).

The board was also concerned with the handling of priorities within matrix structure. It says that "glamour" programs tend to receive the highest quality and quantity of support in sharp contrast to programs of lesser status. If "non-glamour" programs begin to falter, they may not get the added support they need and may be left to continue with even fewer assets than before. This results in the ineffectual use of both fiscal and management personnel resources. "The apparent solution to this problem is program cancellation, but this carries with it the stigma of failure, which we are reluctant to admit" (107).

Harvey is well qualified to write this article since, as a Lieutenant Commander, he served as the ARB coordinator for the Deputy Chief of Naval Materiel for Acquisition. His discussion of matrix management, though, is limited to less than a page and discusses only lessons learned.

Jacobs, D. G. DARCOM direction--the D2 way. Army Logistician, 1984, 16(1), 33-34.

The author briefly describes a new goal-oriented performance management program being used by the Army Materiel Development and Readiness Command (DARCOM). The program is "Thrusts for DARCOM Direction," or D2. He says matrix management provides the framework for the program which was designed to improve the management of DARCOM's more important projects.

Jacob's main point is that matrix enables DARCOM to focus command resources on specific functional areas that require emphasis.

The author's informational basis is his experience working with DARCOM's Directorate for Management from the inception through the implementation of the DARCOM direction program.

The article's discussion on matrix management is limited to introducing it as the framework for D2 and describing why it was selected.

Luper, K. D. Matrix management. Is it for your organization? Armed Forces Comptroller, 1979, 24(3), 22-24.

The question presented in the article's title is exactly what Luper wants his reader to think about as he introduces matrix management and discusses its benefits and problems. In the Department of Defense, he says technological innovations, funding squeezes, and the continual desire to improve performance causes many reorganizations. He warns that such reorganizations with traditional organizational structures often lead to mediocre results. Thus, Luper invites the reader to take a good look at matrix before reorganizing and consider it a candidate.

The author presents several main points. He says, "Matrix management is a system that allows an organization to manage its workload in a horizontal as well as a vertical plane. It can be beneficial or detrimental to an organization. It can be applied for both overhead and projected work" (25). Further, "it is evident that not all organizations should attempt to manage in a matrix mode" (25). But he adds, "This statement does not apply, however, to Department of Defense laboratories" (25).

The article's informational basis appears mainly opinion since the author cites no references. Luper writes from his experience in Naval Research Development Test and Evaluation Laboratories and from his jobs as Systems Accountant, Budget Analyst, and Operations Research Analyst.

This article has the inherent limitations of discussing a broad subject in only four pages, however, the author definitely succeeds in provoking interest in response to his theme question.

Ogan, A. J., & O'Neill, J. H. A proposed material management organization for DoD-National Inventory Control Points. Defense Management Journal, 1981, 17(4), 2-10.

The purpose of the article is to propose a less centralized approach to material management that better serves the military services. Ogan and O'Neill say that the services and the Defense Logistics Agency have inherited a functional approach to logistics support that has the traditional functional organization problems in communications and behavior. Also, noting that all the means necessary to complete the logistics job are not available to any one functional element, the authors propose a commodity management model based on a classic matrix structure. Their alternative organizes along mission rather than functional lines so that units are no longer insulated from one another. This concept gives each manager the tools and information he needs to provide complete customer support.

The authors' main point is that, by matrix, materiel management can integrate the various functional elements of customer support. "It directs the efforts of each element toward mission rather than functional goals" (11).

The article's informational basis has two sources, the authors' experience/opinions and a study. Each author has served in the Defense Logistics Agency and holds a master's degree in logistics management. They also reference the results of a Defense Construction Supply Center study that tested a limited version of this proposal for one year beginning in August 1979.

The article limits itself to the proposed organization structure and does not discuss matrix management principles in general.

Patterson, M. B. Matrix management: Is it right for weapons acquisition?
Program Managers Newsletter, 1978, 7(6), 8-13.

The purpose of this article is to briefly trace the evolution of matrix management and the two management forms (functional and project) that preceded it as they were developed by industry and later adopted by weapons acquisition organizations (8). The author briefly describes benefits and problems inherent in the matrix structure and lists hazards to be expected by weapons acquisition organizations.

Patterson expresses several points. He says matrix improves managing high priority, technically demanding, and rapidly changing programs. However, he adds that an organization's power balance between the program and functional managers must be recognized and resolved or attempts towards a successful matrix will ultimately fail. Patterson also cautions about difficulties in the areas of personnel resistance, increased internal conflict, and matrix management's inherent differences with the traditional military organization structure.

Patterson's information is based on a literature search of three sources and his personal experience. He has served in several program management positions in the Air Force including systems test, procurement and Deputy Systems Director. He has also served on the faculty of the Air War College (13).

The article's discussion of matrix is short and general since the author uses half his content explaining two preceding management forms, functional and project.

Smith, S. A., Jr. Program management orientation handbook (Report Number 2295-80). Maxwell Air Force Base, Alabama: Air Command and Staff College, 1980.

This is a student problem solving project accomplished under the Air Command and Staff College. Smith says program management effectiveness in the Air Force Communication Command (AFCC) has been limited for lack of a

program management training plan and the use of other than program management Air Force specialties to manage AFCC programs. Smith presents his handbook to compliment a training program under development during his writing by providing background, references, and hints on the program management process as applied to communications--electronics equipment/systems.

Smith presents several points on matrix management. He states, "matrix management is used within AFCC because there just aren't enough manpower authorizations available to dedicate an individual to a single program for its duration--and such dedication would be a waste of money since it has been required only infrequently in the past" (49). Citing no authority, Smith says matrix management has been likened to committee management, then he proceeds to give pointers on when and how to use committees. Smith also cautions the program manager (PM) to be alert for understanding where the functional manager's authority ends and where the PM's begins (and vice-versa). Last, he explains how to keep the PM's loaned members loyal to the program and dedicated to the group by publicly praising outstanding performance and keeping functional supervisors well-informed about their subordinates.

Smith's informational basis on matrix management appears mainly opinion. The handbook has numerous references to articles, periodicals, and official documents, yet the section on matrix management cites only one authority and that concerns running committees.

Regarding limitations, the work's section on matrix is less than three pages. There are numerous thoughts for the new PM that are introduced (e.g. "you must understand" or "you should know") but not discussed.

Wall, W. C., Jr. The two-tier matrix organization in project management. Defense Systems Management Review, 1978, 1(7-8), 37-46.

Using a single-tier matrix model as a point of departure, Dr. Wall explains the concept of two-tier matrix organization. He refers to the F-15 fighter acquisition program and the Army's Hawk Project Office as successes with the two-tier approach. Wall concludes by discussing the concept's future implications.

The author's main point is that two-tier matrix provides a vehicle for concentrating planning and control at the sub-project level. This encourages the grouping of similar program elements within the project. He adds, "This aspect helps bring greater focus to major program elements of multifaceted projects and insures that desired management emphasis is afforded each" (46).

Dr. Wall bases his information on eight publications, his 20 years experience in project management with the Army, and his position as Chief, Project Management Office, Hawk Project Office, U.S. Army Missile Readiness Command.

The article limits itself to introducing the two-tier matrix concept and only briefly discusses its applications to the F-15 and HAWK projects.

Wall, W. C., Jr. The general manager of matrix organization. Defense Systems Management Review, 1980, 3(2), 7-15.

Dr. Wall's article is based on the U.S. Army Missile Command's (MICOM) experience with matrix management. He says, "The critical role of the general manager in matrix management is frequently overlooked The roles of and the interaction among the project manager, functional manager, and functional specialist are of vital importance to the effective operation of the matrix.... Matrix management will not achieve its potential, however, unless it is nurtured by the manager at the top of the matrix--the general manager" (7). In this light, the article examines the role of the general manager in his concern and commitment to a successful matrix organization.

Wall says the general manager is not a member of the matrix, yet he has four distinct responsibilities as a result of the management concept. As an administrator he must be an orchestrator, evaluator, decision-maker and resolver/inducer. As a leader, he must act as a director and innovator. As a strategist, he must be a planner and analyst. Finally, as catalyst, the general manager is a synergist and communicator.

The article's information is based on Wall's experience and his literature search of eight sources. At this writing, Dr. Wall was a project office chief and previously served as a deputy project manager.

The article limits itself to the general manager in matrix and provides an excellent chart summarizing the discussion on page 15.

Zambenini, R. L. ASD implements matrix concept. The Air Force Comptroller, 1977, 11(3), 40-41.

As the Comptroller for Aeronautical Systems Division (ASD), Air Force Systems Command (AFSC), Zambenini briefly reports the initial result of ASD implementing the matrix concept. Between February and September 1976, he states that ASD phased in matrix because "the increasing ASD workload and continuing manpower constraints were preventing the adequate manning of new program offices to meet expanding requirements. The work force was fragmented, and the mature SPOs were retaining experienced and highly qualified expertise. Lessons learned were not being shared. The mix of cost analysis and funds management specialty skills in the Program Control offices had become unbalanced as the program advanced through the phases of the acquisition life cycle" (40).

The author's main point is that ASD envisions an increase in productivity with little or no degradation in the concept of the System Program office or the concept of decentralized management. He states that there is nothing inherent in the matrix organization which adversely affects the program manager's ability to perform his duties and responsibilities. Further, Zambenini says matrix has improved the crossfeed of innovative techniques, utilization of uniform procedures, development of new skills, communication between the Comptroller staff and line functions, and cost forecasting.

The article's informational basis is Zambenini's authority as the ASD comptroller.

The report's information is limited by its two pages and by the short amount of time between ASD completing the matrix implementation (Sep 76) and publishing the article (Jul 77).

Literature Review

Bongarts, M.D., & Taylor, M. M. Evaluation criteria for the use of matrix concepts within the Air Force (Report Number LSSR 36-81). Wright-Patterson Air Force Base, Ohio: Air Force Institute of Technology, 1981.

The authors' first objective in this study is to trace the evolution of matrix with its inherent strengths and weaknesses. Second, they sought to develop matrix management evaluation criteria that will enable the organizational decision makers to analyze their present structure to determine if matrix management would enhance mission accomplishment (6).

The authors' points are simplistic and vague. For example, "If the evaluator determines that a change would not be conducive, his work is almost completed. On the other hand, if he has decided to formalize a particular matrix structure, his work has just begun" (49).

Based on a literature search of 47 sources, the article's best information is in tracing the evolution of matrix with its strengths and weaknesses. However, the study's evaluation criteria is vague since the authors ask organizational questions in their survey without describing the nature of responses favorable for matrix organization.

Francis, P. H. Principles of R&D management. New York: AMACOM, 1977.

The author designed this book to be a single reference source from which to teach a graduate course on research and development (R&D) management, both DoD and non-DoD. Francis wrote to satisfy the "need for a management primer in the field of R&D which could easily and usefully be read by professionals working at the interface between technology and business" (vii). His discussion on matrix organization is eight pages in the chapter, "Elements of Organization Theory."

The presentation on matrix is introductory, yet comprehensive in discussing its origin, application, strengths, and weaknesses. Francis leads into the subject by describing the deficiencies of traditional structures, then he introduces matrix organization as the "new approach." He says matrix is particularly suited to the needs of high-technology industry and is successful if top management can regulate the dual-authority structure and intervene in serious conflicts. In order to function effectively, he adds that management information from the program groups must be provided continuously to the functional divisions. "Only in this way can the functional units update their personal allocations across program activities and schedule in-unit work for those not committed to programs" (59). Francis also cautions that "matrix structure complicates the client's need to identify a clear and immediate line of authority directly from the top" (60).

The author's work is an excellent introduction that is packed with information. It cites 11 references among which are Fayol (1949), Blake and Mouton (1964), and Galbraith (1973).

Heath, R. B. Non-traditional organizational design concepts (Report Number 82-1115). Maxwell Air Force Base, Alabama: Air Command and Staff College, 1982.

The author introduces the functional organization format as the U.S. Air Force's traditional organizational structure. However, he says that departures from this format may be helpful to organizations that are subjected to heavy internal demands while trying to deal with their dynamic external environment. Heath describes eight non-traditional organization designs. They are: (1) divisional form; (2) consolidation; (3) project matrix; (4) program matrix; (5) product matrix; (6) management by committee; (7) parallel organizational structure; and (8) team concept. The descriptions are then followed by a discussion evaluating and comparing each to determine when and under what conditions the configurations and concepts can best be applied. Heath also provides a useful summary of each organizational structure in a set of column formatted tables for quick reference.

Heath's study is based on extensive research into concepts from authorities in the fields of management and human relations. Since his subject, though, is really too large to allow thoroughness on any single concept, he recommends that his work be used as a point of departure for a Headquarters Air University Leadership and Management Development Center study project on the use of non-traditional methods and concepts of organization within the Air Force.

Kuhns, J. P. The matrix organization. An application of systems management. Program Manager, 1983, 12(1), 29-31.

As the Director of Planning Management and Administration, Deputy for Development Plans in the U.S. Air Force Armament Division at Eglin Air Force Base, Florida, Kuhns gives a very general look at matrix organization as one approach to systems management.

The author says matrix provides the flexible organizational framework needed to make systems management work, and he cites three conditions which must be present simultaneously for matrix to be the preferred structural choice. These conditions are pressures for sharing personnel resources, for handling a high volume of information, and for handling complex tasks that are too big for one manager to handle.

Kuhns has developed his three page article with references to eight publications on management and organization theory.

Lockheed Missiles & Space Co., Inc. System engineering management guide.
Fort Belvoir, Virginia: Defense Systems Management College, 1983.

This guide was designed as a student text for the Defense Systems Management College, and is also intended to be a desk reference guide for Department of Defense program and project management personnel. The text covers the development of a system from inception to operational deployment and use.

The author steps the reader through functional and project organization to explain how the matrix approach evolved and why it is the best suited organizational format for major systems. Functional organization is inadequate because of "... unclear customer interface, difficult cost/schedule control, unclear communications and control channels, and lack of program recognition and personnel loyalty" (1-7). Pure project organization is unacceptable since "... it tends to be inefficient in that different skills are needed as the programs progress through the acquisition process" (1-7). The author says matrix combines the functional and project approaches and has the following advantages: (1) clear customer interface with single point accountability; (2) short communication channels; (3) high control capability; and (4) assured technology transfer. The only disadvantage cited is that matrix requires cooperation of management to function effectively and ensure that the "two-boss" syndrome does not cause personnel problems (1-7).

The text's handling of matrix organization is limited by its brevity. The discussion takes two pages of which half are organizational drawings.

McKinley, H. L., Jr. Military program management: A guide to wonderland
(Report Number 414-78). Maxwell Air Force Base, Alabama: Air War College, 1978.

As the title suggests, this is a general introduction to program management. "A brief discussion of the program management career field is followed by a summary of currently favored theories of the motivation and management of people. Problem solving and decision making provide the framework for a discussion of rational thought with emphasis on group dynamics. Organization of development programs, source selection, and program formulation are discussed and common errors indicated. The management of contractors and dealing with change introduce a pragmatic discussion of cost and schedule problems. Finally advice on analysis, the use of computers, and program advocacy forms the conclusion" (iii).

In lieu of the term "matrix management," McKinley uses "functional organization" whose program managers depend on people loaned to him/her but who report administratively to a functional manager outside the organization. He introduces this management along with the "line organization" where everyone works permanently for the program manager. Also, he explains that neither line nor functional patterns exist in pure form and each has strengths and weaknesses to compensate for. Functional expertise and economy favor functional organization, while control and motivation favor the line pattern. McKinley maintains

that "... the hold-out for functional organizations in the program office ... really has more basis in job security, entrenched and largely incompetent 'old guards,' and the pressures of certain senior individuals who want to manage something and are demonstrably incapable of bringing off a program" (68).

McKinley's informational basis is research from 20 publications in the fields of human behavior and management and his opinion from serving his entire military career in various research and development activities.

Limited by discussing a broad subject in only 133 pages, McKinley focuses this work's theme on drawing a parallel between program management and Alice in Wonderland and Through the Looking Glass by Charles L. Dodgson.

Melhart, L. J. A study of influence methods used by project and functional managers in a matrix organization environment (Report Number GSM/SM/765-18). Wright-Patterson Air Force Base, Ohio: Air Force Institute of Technology, 1976.

This study examines the vagueness of authority between project and functional managers. Specifically, it looks at the impact of various influence methods that managers employ to compensate for this "authority ambiguity" in order to achieve work group effectiveness.

Melhart's main points are: (1) "Project personnel consider Position and Responsibility to be the most important influence method for both project and immediate functional managers"; (2) "The primary mechanism causing differences in the perception of influence methods is not the different roles that exist within project workgroups, but rather the different superior/subordinate relationship that project personnel have with managers"; (3) "A significant difference exists between the project managers' and the project personnels' perceptions of the Degree of Support that transpires between them"; (4) "Project personnel felt that they gave a higher Degree of Support and were more willing to disagree with their immediate functional managers than with project managers"; (5) "The significant correlations between influence methods and work attitudes depended on whether a particular influence method was being employed by a project manager or an immediate functional manager"; (6) "More than 50% of the military project personnel felt the new OER system had a negative impact on their current job situation"; and (7) "A significant difference exists between the military project personnel's and the project manager's perceptions of the importance of Indirect Performance Rating Influence."

Melhart's information basis was an extensive literature search of 28 works and a survey of ten projects in three program offices. The author conducted an extensive statistical analysis on responses from 49 project personnel on 26 to 30 questions.

The author limited his subject to the Aeronautical Systems Division (ASD) of the Air Force Systems Command (AFSC).

Shearer, R. L. The use of a matrix organization to support development planning in Air Force Systems Command (AFSC) divisions (Report Number AD-A042945). Fort Belvoir, Virginia: Defense Systems Management College, 1977.

This is a student problem solving project. Shearer describes the marginal interface activities between the development planning offices and program offices in the Air Force Systems Command (AFSC) operating divisions.

Shearer believes that marginal performance is caused by people in the two offices responding to different values and objectives. To improve the interface and facilitate the flow of information between organizations, Shearer evaluates the potential use of a matrix type organization. Specifically, he develops the concept of a "reverse" matrix organization where members of a matrix team would be assigned to Development Planning for reporting and evaluation purposes, but would physically work in program offices. "In the normal matrix organization, various functional people are brought together to work on a common problem. Benefit is received by the organization to which people are assigned, and not by their parent functional organization" (17). In Shearer's matrix model "... the term 'reverse' is used to indicate that the primary benefit will accrue not to the office to which people will be assigned, but to the organization which they come" (17). Moreover, the matrix team is composed of members working in different locations and supporting different programs, rather than coming together to work on a common objective.

The study based its proposal on concepts of matrix management by authorities in the field, and limited itself to the AFSC application.

Siau, F. L., III. Organizational structures: Matrix management applications (Report Number 6061). Maxwell Air Force Base, Alabama: Air War College, 1976.

This is a research project providing an introductory exploration of matrix management and a few advantages as well as pitfalls to others attempting matrix for the first time. The author was motivated in his study after experiencing an assignment where "the organization was functionally structured in the formal sense, but formed management teams which crossed the vertical lines to manage specific projects" (1).

Siau found that, "with the proper commitment from top management, the matrix techniques are very applicable to big complex businesses as well as to aerospace projects" (48). Further, many organizations experience pressures that force them to consider a matrix design. The most common pressure is the increased volume of new diverse products.

The author applies his experience to make comments throughout the paper, however, books and periodicals provide the majority of his informational basis. His approach is very "broad brush" with two application examples. These are: (1) A Dow Corning Corporation example based on research; and (2) A Specialized Aircraft Program office example based on personal experiences in his last assignment.

Skowronek, R. P. Matrix management: Is it really conflict management? (Report Number 76-2). Fort Belvoir, Virginia: Defense Systems Management College, 1976.

This is a research report designed to give a comprehensive understanding of one of matrix management's most fundamental characteristics--conflict. "This paper includes: (1) a description of circumstances which tend to intensify conflicts; (2) a listing of those sources or groups with whom conflict is most likely; and (3) a discussion of the impact of various management styles on conflict and methods of conflict resolution" (ii).

Skowronek's prominent conclusions concern conflict intensity and conflict resolution. Intensity of conflict was investigated when dealing with project priorities, administration procedures, technical opinions, manpower resources, cost, schedules, and personalities. Schedules ranked the highest conflict area whereas cost ranked the lowest. Regarding conflict resolution, Skowronek listed five methods. These were withdrawal, smoothing, compromise, forcing, and confrontation. The author says this last method, confrontation, is generally recognized as being the most appropriate method of conflict resolution in most cases (41).

The work's information basis is the result of a literature search of 27 periodicals, books, and reports. In 46 pages, the author has made extensive use of research conducted by Hans J. Thamhain and David L. Wilemon on conflict in a project-oriented work environment, and of Robert R. Blake and Jane S. Mouton's managerial grid and its application to conflict as described by Alan C. Filley (ii).

The author initially gives a general description of matrix management characteristics but develops and restricts his subject to the issue of conflict.

Thurber, K. T. Matrix management: Theory and application in the AFSC product division (Report Number 2520-78). Maxwell Air Force Base, Alabama: Air Command and Staff College, 1978.

This study focuses on basic matrix management theory and examines the 1976 implementation of a full-scale system of matrix management at the Aeronautical Systems Division (ASD), a product division of the Air Force Systems Command.

Thurber summarizes ASD's experience with matrix as follows: (1) The matrix system applied to the acquisition management process has demonstrated the potential to achieve its goals and objectives; (2) A strong system of matrix management is the best organizational response to ASD's current and foreseeable responsibilities and resource constraints; (3) Introducing matrix management requires exhaustive planning, suitable enabling mechanisms, and good communications between both management and employees; (4) Conversion to the system is complex, but it can be accomplished in a relatively smooth manner; and (5) while practical working implementation was accomplished in nine to twelve months, most effective and efficient matrix operations will take three years or more to develop. Thus, the full impact and realization of the benefits of matrix management are not yet evident (87).

The paper's informational basis was a literature search of 26 sources. These include books, articles, periodicals, research studies, official documents, and General Officer correspondence.

Thurber's discussion of ASD's experience in 93 pages of text is thorough and comprehensive. A reader's confidence in these qualities is reinforced by the author's use of four ASD staff presentations on matrix as cited in his bibliography.

Thurber, K. T. The Air Force's experience with matrix management. Defense Management Journal, 1978, 14(6), 16-21.

Thurber reports on the Air Force's experience with matrix in the Aeronautical Systems Division (ASD) since it implemented the concept in September 1976. He gives a general description of matrix management, good points and bad, and discusses complaints against it unique to the military. Two of the unique areas discussed are its difference to the conventional military chain-of-command concept and its effect on the handling of efficiency reports and performance appraisals.

The author's main point is expressed as a quote from Jay R. Galbraith, author of "Matrix Organizations Designs" in the February 1971 issue of Business Horizons. It reads, "For most organizations, the matrix design is the most effective alternative. Managers must be aware of the different kinds of matrix designs and develop some basis for choosing among them" (21). Further, Thurber recommends investigating matrix management for flying organizations and base-level organizations as supply, transportation, life support, maintenance and logistics.

The article's informational basis is the author's literature search of other reports and publications. This article evolved from a research paper Thurber wrote while attending Air Command and Staff College in May 1978.

Overall, the author has written a short article that comprehensively summarizes the ASD experience. His discussions of matrix from the military point of view are excellent and well worth reading.

Data/Survey Results

Banks, J. M. Organizational assessment of a matrix organization: A preliminary investigation into the two boss system within system program offices (Report Number 82-0175). Maxwell Air Force Base, Alabama: Air Command and Staff College, 1982.

The author's goal was to analyze the perceptions of personnel in a matrix organization concerning the effectiveness of their two bosses. Specifically, he wanted to determine "... how project personnel in system program offices of an Air Force Systems Command (AFSC) product division, view the effectiveness of their project manager (PM) versus their functional supervisor" (iii). The author's findings were to "... provide System Program Directors and PMs indicators of how effective PMs are perceived at motivating their project personnel to work together as a team and accomplish a project " (iii).

Banks found that "... project personnel perceive their PMs are at least as effective as their functional supervisors in providing broad overall aspects of management and motivation (i.e., clear and specific job performance goals and recognition for good work). However, PMs were perceived as significantly less effective than functional supervisors in interactions with project personnel (i.e., communication and management/supervision)" (v).

The author used two survey instruments, the Organizational Assessment Package (109 questions) and the Project Manager Survey (41 questions), from the Air Force's Leadership and Management Development Center to establish his informational basis. His sample size was 159 personnel which included 51 officers, 15 enlisted, and 93 civilians.

Bank's work is narrow in scope since it only set out to support or reject five hypotheses by survey and statistical analysis. The actual follow-up to this research paper is to investigate if similar product divisions also have these same characteristics.

Cianfrani, J. T. Analysis and recommendations to improve matrix organization efficiency (Report Number AD-A028 950). Fort Belvoir, Virginia: Defense Systems Management College, 1976.

As the title suggests, the author recommends methods that all matrix managers can use to achieve greater efficiency under their form of organization. Cianfrani began with the hypothesis that a team approach and temporarily locating functional personnel within the program manager's (PM) office should improve present matrix management. His research generally supported this proposal with the addition of some motivational methods used by successful PMs. These methods include: (1) store your charter and system priority; (2) review your staff's size, capabilities, objectives, and functions; (3) determine who will perform the remaining objectives to achieve the overall program management office (PMO) objectives; (4) negotiate detailed work packages with each

functional manager; (5) augment your staff with people experienced in contracting and procurement; (6) establish bi-weekly reviews and a PM backup; (7) establish quarterly reviews; (8) budget for outside contractor supplement; and (9) budget for field trips by functional personnel to work areas.

This study's informational basis was formed from two sources. The first source was a literature review of ideal PM characteristics. The second was ten structured interviews which included five Navy PMOs, two Navy functional organization heads, two contractor PMOs, and a director of a program office equivalent (Cianfrani gives no information on how he selected his sample). Each interview consisted of six questions which are analyzed and summarized in tabular format for easy comparison between the survey's participants.

Conlon, E. J., & Smith, F. Attitudinal correlates of project and function in a matrix organization structure. Iowa City, Iowa: University of Iowa, 1984.

This study explores the relationship between a matrix organization structure and various facets of employee attitudes and perceptions. The authors claim, "Unlike prior studies of such relationships, which focussed mainly on job satisfaction as a criterion, this study explored multiple criteria. Also, this was the first study to examine attitudes and perceptions as correlates of program and function in a matrix" (11).

Conlon and Smith found that "perceptions of Career Development Opportunities and Job Involvement were related to function. Only Goal Quality was related to program residency" (i). The authors only state a relationship exists and do not elaborate or discuss practical applications of their findings.

The authors' study was based on an Air Force survey of 218 "volunteering employees from all SPO's and functions in the focal organization" (8). Offering no other information regarding their sample, the authors launched into a detailed statistical analysis of data gathered by a survey tool called the Organizational Assessment Package.

Overall, this study has several problems. The average manager may find it difficult to understand since it approaches its subject abstractly in a wordy and stilted academia style. For example, "These authors developed a framework which listed and classified the sources of situational variance that might be associated with differences in attitudes across structural boundaries" (2). Moreover, the study immerses itself in analyzing its survey data, yet almost totally ignores discussing the nature of its sample.

Henderson, C. R. Organizational differences: Matrix vs non-matrix (65XX personnel) (Report Number 82-1135). Maxwell Air Force Base, Alabama: Air Command and Staff College, 1982.

This is a research report to determine the impact of matrix management on job satisfaction, perceived productivity, and career intentions of Air Force Manufacturing/Quality Assurance Officers (65XX personnel). During the 1970's,

the Air Force Systems Command changed its organization structure from non-matrix to matrix management in order to maximize the use of key, limited technical personnel in contracting, manufacturing, and engineering. The author was personally involved in this transition and found its first six months to be "an absolute endurance test."

Henderson found that matrix organization can have either positive or negative impacts on an individual depending heavily upon his/her "... willingness to operate in a fluid environment and the manager's ability to take the complexity of matrix and provide a good, healthy environment for the workers" (viii).

The research data were gathered by the Air Force Leadership and Management Development Center in a survey of 65XX personnel. The sampling was not balanced since it questioned only 12 officers and GS civilians under matrix management compared to 452 officers and civilians under non-matrix. This was a likely factor in the survey results differing from the study's literature findings in many ways.

Losi, D. The program manager and the matrix organization (Report Number 77-2).
Fort Belvoir, Virginia: Defense Systems Management College, 1977.

This is a project report that summarizes an investigation of the principal problem areas encountered by a program manager operating in a matrix organization. As his matrix subject, Losi chose to survey the Aeronautical Systems Division (ASD) of the Air Force Systems Command (AFSC) located at Wright-Patterson Air Force Base, Ohio.

Losi summarizes matrix problems at ASD into seven categories and offers recommendations towards their solution. First is "Conflict Areas" which includes manpower allocation, personnel loyalty, technical/contract issues, functional response, and social interaction. Second is "Communications" between the functions and the program office, personality dependent, and on the management level. The remaining categories are "Authority Ambiguity," "Performance Appraisal," "Program Priority," "Resource Savings," and "Collocation/Corporate Memory." Losi offers seven recommendations: (1) Encourage open communications; (2) Conduct periodic functional/program reviews; (3) Document agreements; (4) Develop standardized functional/program forecasting techniques; (5) Resolve conflicts by negotiation over withdrawal, smoothing, and forcing techniques; (6) Educate all personnel as to the nature and dynamics of the specific matrix structure; and (7) Hire consultants to periodically assess organizational health.

The paper's informational basis is formed from 22 publications and from structured interviews with ten ASD personnel "keenly familiar with the ASD structure" and "serving in positions at the crossroads of the functional and program groups" (25).

The author limited himself to ASD since he sought to correlate his findings with earlier studies by Moyer, Melhart and Tsukamoto.

Moyer, C. L. The matrix organization in ASD: A study in collocation of engineers (Report Number AD A003604). Wright-Patterson Air Force Base, Ohio: Air Force Institute of Technology, 1974.

Moyer's study is directed to benefit the Aeronautical Systems Division (ASD) of the Air Force Systems Command. At the time of her writing, this was an organization already using matrix management with engineers collocated with the Program Manager (PM). She recommends improvements to the existing matrix organization and seeks to alleviate human relations problems which were perceived by the engineers she interviewed. Recommendations fell into eight categories: (1) motive value system; (2) consultation with home office; (3) performance ratings and promotions; (4) maintaining technical currency and increasing expertise; (5) choice in selection and length of work assignments; (6) work content; (7) job satisfaction; and (8) need for three types of work assignments. Each include a general situational description followed by a specific finding with its recommended solution. The solutions most often detailed matrix management techniques that would be useful in general applications as well as the specific finding.

The author's information is based on results from a survey "designed to determine the work motive values, job satisfaction, and the current work conditions or climate as perceived by the engineers interviewed" (i). Recommendations appear to be based on her opinion and the application of concepts from authorities in the fields of management and human behavior noted in her bibliography.

Concerning the study's limitations, Moyer selected only one directorate within ASD and assumed it to be representative. However, her sample was extensive and included 87 engineer interviews using a 39 question survey.

Thamhain, H. J., & Wilemon, D. L. The effective management of conflict in project-oriented work environments. Defense Management Journal, 1975, 11(3), 29-40.

As the title indicates, this article discusses the conflict situations which arise in the administering of project-oriented work environments. Although it does not use the term "matrix management," it specifically addresses the concept's inherent conflict between project managers and the functional departments.

The authors establish several points empirically. In descending order of intensity, the following subjects represent areas of conflict: Schedules, priorities, manpower, technical issues, administration, personality conflict, and cost objectives. In descending order of preference, the following are modes of conflict resolution: Confrontation, compromise, smoothing, forcing, and withdrawal. In descending order of significance, the following are factors important in support of project management: Expertise, authority, work challenge, friendship, future work assignments, promotion, fund allocation, salary, and penalty.

Although the authors have 12 source references, their findings are based upon a survey of project managers in approximately 150 technology-oriented companies, resulting in a usable sample of 100 project managers. The sample covers a wide variety of project management situations such as airplane production, computer installation, facilities construction and research and development. A sample of the questionnaire was not included.

The authors limited their discussion to the general subject of conflict in project-oriented work environments without specifying "matrix management." They thoroughly discussed their survey results and summarized their findings on eight graphs.

Tsukamoto, W. S. A study of the personnel problems in a U.S. Air Force matrix organization (Report Number GM/SM/73-25). Wright-Patterson Air Force Base, Ohio: Air Force Institute of Technology, 1973.

"This study explores the differences in perceptions of personnel problems that exist in an Air Force matrix organization between the engineers assigned to functional organizations and the engineers administratively assigned to functional organizations, but temporarily located in a program organization" (ia). Tsukamoto refers to the former as "functional engineers" and the latter as "collocated engineers."

The author states the following major findings: (1) Each type engineer believed that the other had the promotion advantage; (2) Functional engineers viewed collocation as narrowing one's professional expertise, but the collocated engineer believed it was career broadening; (3) Both type engineers believed there was poor information exchange on technical matters between collocated and functional engineers; and (4) Both types agreed that collocated personnel had to be rotated regularly back to their functionally located colleagues in order to share experiences and catch up with the state of art advances.

Tsukamoto gathered his data from sampling Civil Service engineers of the Air Force Systems Command, Aeronautical Systems Division (ASD). He used a formal questionnaire seeking responses to 11 specific problem areas, and he used parametric and non-parametric statistical methods in his analysis. Two of the author's major findings, described above, were popularly volunteered by the respondents and were not part of the original survey plan. Tsukamoto's target sample was eighty engineers in four ASD directorates with an equal distribution between collocated and functionally located individuals. The percentage responding was 67.5%.

The study was limited on two aspects: (1) It surveyed only one Air Force organization using matrix; and (2) It assumed the 67.5% survey response was a representative sample of the total population of functional and collocated engineers at ASD.

Nelson, E. B. Matrix management techniques in USAF R&D programs (Report Number 431-78). Maxwell Air Force Base, Alabama: Air War College, 1978.

This is a research report submitted to the faculty of the Air University Air War College. "The author reviews organizational concepts in general and discusses the matrix concept in some detail. The major position of the report delineates matrix management policies of twenty large contractors doing business with the Air Force Systems Command (AFSC). Conclusions applicable to AFSC Product Divisions are drawn from organizational theory and from the contractor practices" (iii).

Nelson arrives at his main point in comparing the matrix management practices of the aerospace contractors to those of the AFSC Product Divisions. He found that almost all the contractor's functional support interfaces were task rather than people-oriented, with the contract work breakdown structure frequently being used to establish the tasks to be accomplished. The functional managers almost universally maintained control over their personnel (40). Moreover, Nelson says this task-oriented interface, not common in the AFSC Product Divisions, is efficient in usage of manpower and application of corporate memory. He recommends that the Product Division policy of supplying people to program offices be re-examined carefully to find opportunities for replacing this procedure with a task interface where possible (41).

Nelson bases his information on research from 31 publications on management and behavior and from a survey of twenty aerospace contractors.

Regarding the work's limitations, the author discusses matrix principles, his survey, and draws conclusions, all in 41 pages. This is an ambitious task for the limited space, but his subject development serves his main point very well. Nelson based his survey on subjects doing major business with AFSC in FY 78 and drew his data from requested company operating procedures.

Official Guidance

U.S. Government Printing Office. Acquisition management: A guide for program management, AFSCP 800-3. Washington, D.C.: Author, 1976.

Containing updates as late as October 1983, "This pamphlet describes the general considerations involved in managing the acquisition of a system. The first five chapters illustrate the general sequence of events in the system life cycle, with the succeeding chapters addressing principal processes which may be accomplished during acquisition, in varying scope and degree, according to the needs of individual programs" (1).

Although matrix management is a common tool of the Program Manager (PM), the pamphlet does not address the concept at all. The chapter on Program Office Organization offers only broad statements like, "the specific internal organizational configuration for the PO is a prerogative of the Program Manager," and "the PM has ample opportunity to apply management innovations streamlining to increase management efficiency and effectiveness" (20-4). Although the document omits addressing specific management techniques, its functional organization charts are used in another publication's discussion of matrix management. Specifically, figure 20-5, "Typical Deputy for Systems Management," also appears in Air University's 1984 issue of Creating and Sustaining Military Capability. The Air University uses figure 20-5 to illustrate one of the reasons for matrix organization.

Overall, the pamphlet is of limited value to the matrix organization researcher since it does not address specific management techniques, and it spreads itself over 22 major subjects in system acquisition.

U.S. Government Printing Office. Manpower organization policy and guidance, AFR 26-2. Washington, D.C.: Author, 1982.

"This regulation describes the principles and policies of Air Force organization. It explains the various organization units, shows the standard structures for some of them, and gives procedures for establishing organizations and making changes" (1).

The regulation's first chapter is the most pertinent when looking for guidance on matrix organization. Although it does not mention matrix specifically, it addresses the concept's topics of concern. For example, AFR 26-2 says each person's responsibilities must be clearly defined, and each person must be held accountable to only one superior for performing specific responsibilities. It also says Air Force objectives in organization structure are to keep pace with technological advances, changing mission, concepts of operation and to streamline the decision making process. The regulation appears flexible in its direction by stating, "Organization based on functions... predominates in the overall Air Force structure. However, in an organization

as large and complex as the Air Force, the functional approach does not always apply. It is also important to recognize that a particular unit may be organized by function but its subordinate elements may be organized differently" (6). Paragraph 1-19 is particularly noteworthy in its statement, "MAJCOMs are encouraged to develop and test new organizations that promise to increase effectiveness and efficiency" (7).

"Although this regulation applies Air Force-wide, the standard structures apply primarily to wing and base level organizations" (1).

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